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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/010,484

11/20/2001

Fwu-Iuan Hshieh

GS 150

7850

27774

7590

12/04/2002

MAYER, FORTKORT & WILLIAMS, PC
251 NORTH AVENUE WEST
2ND FLOOR
WESTFIELD, NJ 07090

EXAMINER

TRAN, TAN N

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 12/04/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/010,484

Applicant(s)

HSHIEH ET AL.

Examiner

TAN N TRAN

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 November 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) 17-21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>2</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restriction

1. Applicant's election without traverse of Group I, claims 1-16 in Paper No. 7 is acknowledged.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-9,11-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hshieh et al. (6,472,678) in view of Luo (6,251,730).

With regard to claims 1,7,14,15,16, Hshieh et al. discloses a silicon substrate 200 of a first conductivity type (N-type); a silicon epitaxial layer 202 of the first conductivity type (N-type) over the substrate 200, the epitaxial layer 202 having a lower majority carrier concentration than the substrate 200; a trench extending into the epitaxial layer 202 from an upper surface of the epitaxial layer 202; a doped polycrystalline silicon conductive region 211 within the trench adjacent a insulating layer 210; the insulating layer 210 lining at least a portion of the trench; a conductive region 211 within the trench adjacent the insulating layer 210; a body region 204 of a second conductivity type provided within an upper portion of the epitaxial layer 202 and adjacent to the trench; a source region 214 of the first conductivity type provided within an upper portion of the body region 204 and adjacent the trench; an upper region 212 of second conductivity type within an upper portion of the body region 204 and adjacent the source region

214, the upper region having a higher majority carrier concentration than the body region 204; a borophosilicate glass insulating region 216 disposed over the conductive region, the insulating region 210 extending above the epitaxial layer upper surface; a source contact region 214 disposed on the epitaxial layer upper surface and laterally adjacent the insulating region 210. (Note lines 30-33, column 6, figs. 1,3E of Hshieh et al.).

Hshieh et al. does not disclose a silicon oxide insulating layer lining at least a portion of the trench, the source contact region comprising: a doped polycrystalline silicon contact region in electrical contact with the source region and a metal contact region adjacent the doped polycrystalline silicon contact region and in electrical contact with the source region and with the upper region.

However, Luo discloses a silicon oxide insulating layer 50 lining at least a portion of the trench, the source contact region 13b comprising: a doped polycrystalline silicon contact region 13a in electrical contact with the source region 13b and a metal contact region 33 adjacent the doped polycrystalline silicon contact region 13a and in electrical contact with the source region 13b and with the upper region. (Note lines 44-46, column 7, figs. 4,7,8 of Luo).

Therefore, it would have been obvious to one of ordinary skill in the art to form the Hshieh et al.'s device having the source contact region 13b comprising: a doped polycrystalline silicon contact region 13a in electrical contact with the source region 13b and a metal contact region 33 adjacent the doped polycrystalline silicon contact region 13a and in electrical contact with the source region 13b and with the upper region such as taught by Luo in order to expose a peripheral area of the doped source portion formed in the body.

With regard to claim 2, Luo discloses metal contact region 33 comprises aluminum. (Note lines 40,41, column 7, figs. 7,8 of Luo).

With regard to claim 3, Luo discloses the doped polycrystalline silicon contact region 13a is an N-type polycrystalline silicon region. (Note lines 44-46, column 7, figs. 7,8 of Luo).

With regard to claim 4, Hshieh et al. and Luo disclose all claimed invention as in claim 3, except doped polycrystalline silicon contact region has a doping concentration ranging from 5×10^{19} to $1 \times 10^{20} \text{ cm}^{-3}$. However, although Hshieh et al. and Luo do not teach exact doping concentration of doped polycrystalline silicon contact region as that claimed by Applicant, the doping concentration of differences are considered obvious design choices and are not patentable unless unobvious or expected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note in re Leshin, 125 USPQ 416.

With regard to claim 5, Luo discloses the doped polycrystalline silicon contact region 13a is substantially triangular in cross-section. (Note figs. 7,8 of Luo).

With regard to claim 6, Hshieh et al. discloses an insulating region 216 disposed over the conductive region 211, the insulating region 216 extending above the epitaxial layer upper surface 202. (Note figs. 1,3E of Hshieh et al.).

With regard to claim 8, Luo discloses the doped polycrystalline silicon contact region 13a is positioned laterally adjacent to the insulating region 22. (Note figs. 7,8,9 of Luo).

With regard to claim 9, Luo discloses a thickness of the doped polycrystalline silicon contact region 13a is greatest adjacent the insulating region 22, and wherein an upper surface of

the doped polycrystalline silicon contact region 13a slopes away from the insulating region 22. (Note figs. 7,8,9 of Luo).

With regard to claim 11, Luo discloses the device comprises a plurality of transistor cells of square geometry or hexagonal geometry. (Note lines 21-27, column 5 of Luo).

With regard to claim 12, Luo discloses the insulating layer 50 is a silicon oxide layer. (Note lines 57-58, column 5, fig. 4 of Luo).

With regard to claim 13, Luo discloses the conductive region 11 comprises doped polycrystalline silicon. (Note lines 46-48, column 8, fig. 5 of Luo).

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hshieh et al. (6,472,678) in view of Luo (6,251,730) and further in view of Applicant's prior art (APA) in figs. 1 and 2.

Hshieh et al. and Luo do not disclose an additional region of second conductivity type immediately below the upper region, the additional region having a higher majority carrier concentration than the body region.

However, APA discloses an additional region 139 of second conductivity type immediately below the upper region, the additional region having a higher majority carrier concentration than the body region 130. (Note figs. 1,2).

Therefore, it would have been obvious to one of ordinary skill in the art to form the Hshieh et al. and Luo's device having an additional region of second conductivity type immediately below the upper region, the additional region having a higher majority carrier concentration than the body region such as taught by APA in order to reduce the contact resistance at the metal contact.

Conclusion

3. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Tan Tran whose telephone number is (703) 305-3362. The examiner can normally be reached on M-F 8:30AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (703) 308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for after final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

TT

Nov 2002


NATHAN J. FLYNN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800